c. ♂. Lake Tinero, Baro River, March 26th.

d, *e*. ♂. Ibaga, Baro River, March 27th.

The male bird described by Mr. Neumann as belonging to a new subspecies was procured at Lake Tata, on the Gelo, within a hundred miles of the Baro River; but our specimens from the same district do not differ in any way from the typical *V. waalia*. Among the examples collected by Mr. E. Degen in Abyssinia there is one agreeing more or less with the description of *V. w. cinereiceps*.

143. Numida ptilorhyncha.

Numida ptilorhyncha Licht.; Grant, p. 469; Butler, p. 388.

a, *b*. ♀. Ibaga, Baro River, March 27th.

XXXIV.—*Suggestions as to the Functions of the Entotympanic Muscle in the Common Snipe.* By W. H. Workman, M.B.O.U.

While I was snipe-shooting towards the end of last year my attention was specially drawn to the construction of the bill of the Common Snipe (*Gallinago cœlestis*); and I examined the heads of a number of specimens with a view to finding out the means by which the soft and pliable anterior part of the upper mandible is lifted.

The fact of this bird being able to raise the tip of the upper mandible seems to be well known, as Professor Newton says:—

"The flexible part commonly lies behind the nasal cavities, but in *Trochili* and *Scolopacidæ* far in front of the nostrils, so that only the anterior part of the upper mandible is movable, and motion can be effected while the mouth is closed. In some Plovers and Ibises, and probably a few other birds also, such a flexible region exists besides the usual fronto-nasal one." *

M. Hérissant, in an article entitled "Observations Anatomiques sur les Mouvements du Bec des Oiseaux," in 'Histoire

* Dict. B. p. 877, note 2.

de l'Académie Royale des Sciences,' 1748 (published in Paris in 1752), pp. 345–386, pls. 15–23, gives a most interesting account of his observations on various birds, which might well be reprinted in full for the benefit of those who have not access to this rare volume. Hérissant observed two different movements when a bird opens its beak, the ordinary method of lowering the point of the lower mandible and, secondly, a tilting of the upper mandible. I give below a translation of the part of his paper dealing with the muscles employed in this action, which is particularly interesting, as there is a certain similarity between this description and my observations on the Snipe. On pp. 370–372 Hérissant describes the muscles used to open the bill as follows :—

"The first of these muscles is that which I have just described; when contracting, it begins to raise feebly the posterior extremity of the lower mandible.

"The second is a little flat one, fleshy and almost triangular, placed obliquely behind the quadrate, which it so nearly touches that its anterior fibres are obliged to bend in order to give room for the inferior posterior angle of this bone. I shall call this the Triangular Muscle.

"It is attached along the posterior edge of the external auditory meatus and to the mastoid apophysis; from there it descends obliquely from behind forwards, above a strong ligament, to which it is adherent, and passes underneath the posterior inferior angle of the quadrate. Subsequently it goes to a fleshy insertion on the external face and even on the edge of the apophysis which terminates posteriorly each branch of the lower mandible immediately behind the articular surface seen there.

"The third muscle is a little longer, broader, and thicker than the former; it is situated at the lateral internal part of the serpiform apophysis of the lower mandible. Its shape approaches that of a square, one of the angles of which is lengthened out more than the other. I shall call this the Square Muscle.

"It is attached above to the lateral internal face of the mastoid apophysis by a flat surface, partly fleshy and partly

sinewy, and fills the entire hollow which one sees there; it then descends a little obliquely in order to attach itself by a fleshy mass to the lateral internal face of the serpiform apophysis, and occupies the fossa to be observed under the articular face of the lower mandible. This muscle is, moreover, attached along the posterior edge of the styloid apophysis, which is close to the articular face that I have just mentioned. It is separated from the foregoing by the ligament of which I have already spoken, which is placed between them both, to give them their attachment.

"All these muscles, on being contracted together, strongly elevate the posterior extremities and even the two articular surfaces of the lower mandible, which, being joined loosely with the lower edge of each quadrate, raise this bone and push it at the same time outwards and forwards, whilst its superior posterior angle rolls on itself in a different direction in the articular cavity of the skull where it is received.

"You will still more readily conceive how the two quadrates may be drawn forward, if you recollect that the anterior fibres of the Triangular Muscle are bent to form a cavity destined to lodge the posterior inferior angle of this bone, which has the effect that, when these muscles come to contract, their anterior or bent fibres tend to straighten themselves, and in consequence force in front the two quadrates, the articulation of which with the base of the skull permits them to move very easily.

"The fourth muscle which co-operates to lift the upper mandible is placed in each orbital fossa on the partition; it is attached by a little fleshy belly under the optic foramen and descends, gathering up its fibres to be inserted in the anterior superior angle of the quadrate and the adjacent parts.

"When this muscle acts, it draws upwards, inwards, and a little backwards the angle of the quadrate to which it is attached, and consequently forces the two inferior angles to advance, which has the effect that the slender or external branch which goes to the upper mandible, being joined by planiform or orbicular diarthrosis with the quadrate, finds

itself pushed forward to raise on one side the lower mandible, at the same time that on the other side this same branch moves on the posterior inferior angle of the quadrate.

"Lastly, the fifth muscle somewhat resembles a little pyramid reversed and flattened, so that I shall name it the Little Pyramidal. It is placed at the bottom of the orbital fossa, but more anteriorly than the foregoing, with which it seems to coalesce, although elsewhere these two muscles are quite separated, the one from the other, by their tendon.

"It is attached superiorly by a fleshy belly to the orbital partition and descends obliquely from above downwards, but from before backwards, its fibres converging to end in a little tendon, which is inserted in the superior edge of the posterior extremity of the omoid bone close to its articulation with the quadrate. This muscle has a direction so oblique that it makes a very acute angle with the omoid bone.

"To properly observe this muscle and the preceding one, you only need to remove the eyeball from the orbital fossa, with a large gland which is below, then without much preparation they appear very distinctly.

"The use of the fifth pair of muscles is to pull the omoid bone forwards and a little upwards.

"The anatomical exposition of the muscles of which I have just spoken suffices of itself to make you understand that these organs all contracting at the same time necessarily cause the elevation of the lower mandible. Indeed, the first, second, and third pair of these muscles on contracting elevate strongly the posterior extremities of each branch of the lower mandible, which has the effect that the inferior part of the quadrate, as I have already said, is pushed upwards, forwards, and outwards."

As will be seen, the latter part of this quotation concerns the entotympanic muscle.

To return to my own experiences on the Snipe, I began by stripping off the skin and feathers of the head, to reveal the exterior bones, especially those connected with the bill. I found the upper mandible to be chiefly composed of the *premaxillary*,

which is rigidly fused to the frontal bones of the skull; next I found the *maxillary* running along the edges of the premaxillary and incased in a blackish sheath, but not attached rigidly to it. This bone divides posteriorly, the maxillary portion running upwards to the frontals, where it is attached. The other part is continued by the *jugal* and the *quadrato-jugal*, this latter being attached to the quadrate which lies just beneath the ear-cavity. Now, by grasping the upper mandible of a fresh specimen about the middle with my finger and thumb, and catching the maxillary at the fork with a pair of forceps, I found by moving the forceps I was able with very little force to push the maxillary forward, and so lift the anterior part of the upper mandible, as shown in the figure (p. 619), and also depress it by reversing the action.

As to the muscles concerned in carrying out this movement, it will be seen from the account given by Hérissant how they act in birds generally, but an account of my own experiments may be of interest to the readers of 'The Ibis.'

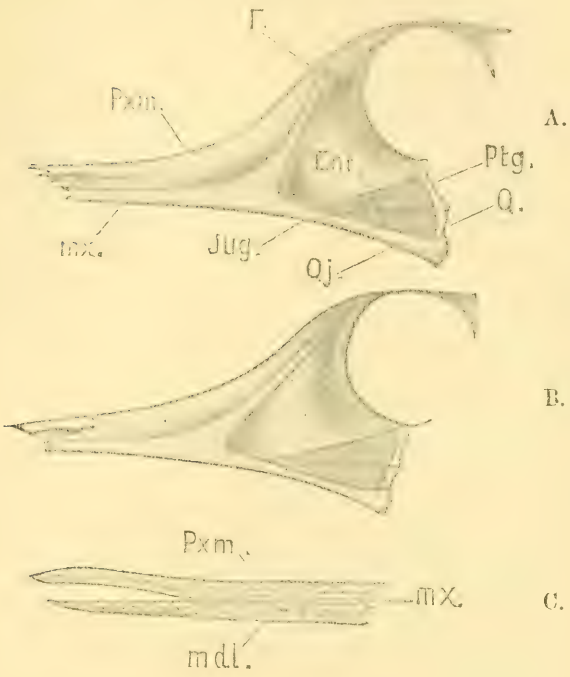
I made a number of dissections and found that the entotympanic muscle was the muscle that pulled forward the quadrate and pterygoid bones. This is Shufeldt's * description of it:—"The entotympanic is a small, spindle-shaped muscle, which arises quite fleshy from the sides of the basisphenoid, and to a limited extent from the base of the rostrum immediately beyond it. As it passes backwards and downwards, it rapidly contracts to form a double tendinous slip. One of these is inserted into a little spine-like process on the upper side of the shaft of the corresponding pterygoid, close to its quadratal articular end. The other is inserted into the quadrate itself, close to the pterygoidal articulation, and to its outer side.

"When these muscles contract, they pull forward the quadrates and pterygoids, which latter, in pushing against the palatines, tend to raise the superior mandible."

Now I found, on carefully removing the pterygoideus

* 'Myology of the Raven,' pp. 19, 20.

Text-figure 34.



Rough sketch shewing the action of the entotympanic muscle of the Common Snipe.
(Semi-diagrammatic.)

A = Sketch shewing the position of the muscle.
B = Sketch to illustrate the muscle contracted.
C = Sketch shewing the effect of contraction of the muscle on the anterior portion of the bill.

Pxm. = Premaxillary.
mx. = Maxillary.
F. = „ attachment to frontal bone.
mdl. = Mandible.
Jug. = Jugal.
Q. = Quadrate.
Qj. = Quadrato-jugal.
Ptg. = Pterygoid.
Ent. = Entotympanic muscle.

internus, that immediately beneath it there lay a large muscle, which appeared to be, in the Snipe, the counterpart of the entotympanic in the Raven, but relatively very much more powerful, as I had expected.

This muscle, instead of running obliquely across the skull as in the Raven, has a powerful origin, and runs almost directly backwards, at the same time dividing into two slips, one of which is strongly attached to the quadrate, and the other equally strongly to the pterygoid, as illustrated in the figure.

Now we may suppose when these muscles contract they pull forward the quadrates and pterygoids. They in turn would transmit this movement to the quadrato-jugals, jugals, and maxillaries. The thrust of the maxillary would in turn be conveyed to the premaxillary, which naturally would yield at its most flexible part—about an inch, in the Common Snipe, from the tip, as shown in the figure (text-fig. 34, p. 619). Now that this is what takes place I think may be proved by making a dissection as described above, so as to lay bare the entotympanic muscle, then move up and down the tip of the upper mandible, watching the while the action of the muscles. This, taken with the movement of the maxillary when held with the forceps as described above, would seem to be fair proof that such an action exists. It also seems reasonable to suppose that a Snipe which gets its food in soft heavy ground would find, on pushing down its long bill, great difficulty in opening it enough to grasp the small insects, &c., of the presence of which the nerves at the tip of the upper mandible have already given warning. How much more easy would it be if only the tip were lifted or opened just enough to catch its food, which would be firmly held till withdrawn from the ground, when the tongue and tooth-like processes on the upper mandible would draw the prey into the mouth. Again, if the Snipe was to open the whole beak when submerged, mud and other foreign matter would fill up the tooth-like processes and interfere with the swallowing of the food.

In concluding this short paper, I should like to add that